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Research Article

Proximate and mineral composition of commercially important marine fin fishes from the Kasimedu fish landing centre Chennai

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ABSTRACT

The present study was carried out to analyse the proximate and mineral composition of commercially important marine fin fishes landed in Kasimedu coast, for their nutritive value. The results showed that there was a significant difference ($p < 0.05$) in all the parameters, moisture content ranges from (72.37 to 77.90 %). Crude protein ranges from (65.61 to 77.90 %). Highest crude protein was observed in *Amblygaster sirm* and *Rastrelliger brachysoma*. The crude lipid content varies from (1.31 to 8.68 %) with *Sphyraena flavicauda* showed the highest lipid content of (8.68 %). The average total ash content of fishes ranges from (14.57 to 25.44 %) and two species, *Nemipterus japonicus* and *Epinephelus fuscoguttatus* showed highest values of (22.1 and 25.44%), Similarly highest carbohydrates content was observed in *E. fuscoguttatus* (6.13%). The body indices hepatosomatic index, viscerosomatic index, gonado somatic index and condition factor showed significant differences ($p < 0.05$) among the fishes. Similarly higher iron and calcium content was observed in *Amblygaster*, *R. brachysoma* and *Epinephelus*. Most of fishes are rich source of phosphorus. The results of the study revealed that analyzed fish samples were good sources of nutrients and minerals could provide health benefits if consumed in moderate level.

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INTRODUCTION

The world's demand for aquatic source of food is on the rise not only because of its growing population, but also because of a preference for healthier foods for human beings (Njinkoue *et al.*, 2016) Fish is one of the cheapest sources of marine protein contains essential nutrients, very little connective tissue and easily digestible for that reason, fish is recommended in human diets (Soundarapandian *et al.*, 2013) Fish meat contains particularly low fat and higher moisture than mutton, beef or chicken and is favoured over other red or white meats (Elagba *et al.*, 2010). The nutritional value of fish meat comprises of moisture, protein, lipids, vitamins and minerals and the caloric value of the fish (Steffens, 2006). Fish proteins have high biological values because they are characterized by the presence of essential amino acids in good proportions. Fishes are also richest sources of ω3 polyunsaturated fatty acids. Many studies have shown that eicosapentaenoic acid (EPA or 20:5ω3) and docosahexaenoic acid (DHA or 22:6ω3) are present in higher amounts in fish tissues (Rasoarahona *et al.*, 2005). These polyunsaturated fatty acids have been shown to play a vital role in human nutrition. They also have curative and preventive effects on many human diseases such as cardiovascular diseases, cancers, rheumatoid arthritis, and inflammation (Raatz *et al.*, 2013). Minerals play a vital role in maintaining body functions because they maintain acid–base balance, and help in haemoglobin formation (Duran *et al.*, 2010). They also control the water balance in the body, help bones formation and teeth structure, and catalyze many metabolic reactions (Mendil *et al.*, 2010). The most important minerals calcium, sodium, potassium, phosphorous and iron while many others are also needed in trace amounts (Nurnada *et al.*, 2013). The deficiency of these importnat mineral elements induces a lot of malfunctioning as it reduces productivity and causes diseases, such as inability of blood to clot, osteoporosis, anemia etc. (Njinkoue *et al.*, 2016).

Studies on the nutrient composition of fishes have been reported in relation to different aspects of fishes rather than their energy value. However, very few studies have been reported on the nutritive and calorific value of fishes (Ravichandran *et al.*, 2012). The knowledge of the nutrient composition of any edible organisms is extremely important since the nutritive value is reflected in its biochemical

contents (Soundarapandian *et al.,* 2013). Previous studies have reported the proximate composition of fishes landed in Thoothukudi, Nagapattinam, Parangipettai and Orissa Coasts are mainly examined for their proximate composition (Mathana *et al.,* 2012). However studies on the Kasimedu fish landing centre has not been reported so far. Therefore, the present study was carried out to assess the proximate and mineral composition of commercially important marine fin fishes from the Kasimedu fish landing centre

MATERIALS AND METHODS

Source of fishes

The fish species Spotted sardinella (*Amblygaster sirm*), Indian anchovy (*Stolephorus indicus*), Thread fin bream (*Nemipterus japonicas*), Indian mackerel (*Rastrelliger brachysoma*), Tiger grouper (*Epinephelus fuscoguttatus*), Yellowtail barracuda (*Sphyraena flavicauda*) and Lizard fish (*Saurida undosquamis*) (Figures 1-7) were chosen and purchased fresh on the boats as soon as they arrived in the Kasimedu fish landing centre in early hours of morning. The fish samples were preserved in icebox containing ice. The fishes were brought to Central Institute of Brackishwater Aquaculture (CIBA) Nutrition Laboratory, Chennai-19. The morphometric parameters of each fish were determined.

Morphometric parameters

The morphometric parameters like total length, body weight, standard length, breath of the body, length of the head, and diameter of the eye were measured on a scale, the measurements were made in cm and the body indices were determined following the standardized protocols (Ali *et al.,* 2017).

Sample preparation

After morphometric measurement, fishes were dissected with a cleaned stainless steel knife. The fish samples were ground in an electrical grinder and dried at 105°C for 12 h. The oven-dried samples were packed in air tight containers and stored in a dessicator until use for subsequent chemical analysis. The following parameters were determined for below mentioned fishes which include moisture crude protein, crude lipid, total ash and carbohydrates by using the standard methods (AOAC 1990).

Chemical analysis

Moisture content was estimated by gravimetric analysis after oven drying at 105°C for 12 h. Crude protein (CP) was determined by Kjeldahl method (N x 6.25) after acid hydrolysis (Kjeltec 2100, FOSS, Tecator, Sweden). Crude lipid (CL) was calculated gravimetrically after extraction with petroleum ether in a soxhlet system (SOCS, Pelican, India). Total ash was determined gravimetrically by ignition at 600°C for 6 h in muffle furnace. Crude fiber was estimated gravimetrically after acid and alkali digestion and loss in mass by combustion at 600°C for 3 h. Nitrogen free extract (NFE) was calculated from 1000 − (crude protein + crude lipid + crude fiber + total ash). All the chemical analyses were done in triplicate and reported on a dry matter basis.

Mineral analysis

Moisture free fish sample was used for the preparation of the ash solution. Approximately, 2 g of sample was taken in a silica crucible and placed in the Muffle furnace set at 600˚C for 6 h until the residue is clear white. To this residue, conc. HCl acid was added to dissolve the ash and the residual acid was evaporated to dryness by placing in a hot plate (Technico, Chennai, India). This process was repeated again. The ash solution was then filtered through Whatman No. 1 filter paper and rinsed again with hot distilled water and made up to 50 ml with distilled water. This ash solution was used for the estimation of calcium, phosphorus, and iron contents (AOAC 1990).

Statistical analysis

Data were analyzed using one-way analysis of variance (ANOVA) to compare significant differences between treatments, whereas Duncan's multiple range tests were used to compare the means of the treatment. The data were analyzed using SPSS version 16.0 software.

RESULTS AND DISCUSSION

The various morphometric parameters of seven fishes belonging to the different families are presented in (Table 1). The average length of the fishes ranged widely from 12.1 to 23.4 cm. Majority of the fishes was medium sized with the average lengths between 12 to 23 cm. The species of the families, Engraulidae were the small having the average length of 12 cm, respectively. The species, of *E. fuscoguttatus* belonging to the family Serranidae was the longest fish examined with an average length and weight of 23.4 cm and 154.3g. The average weights of majority of the fish species were below 75 g.

The body indices of fishes showed significant differences ($p < 0.05$) in condition factor, hepatosomatic index, viscera somatic index and gonado somatic index (Table 3). The condition factor was highest in *S. japonicas* compared to other fishes. However HSI, VSI and GSI showed the highest values in *M. cepahlus.*

The proximate composition of fishes caught in Kasimedu landing centre is presented in (Table 4).The average moisture content of the fishes ranges from 72.3% to 77.9%. The species, *S. flavicauda* belonging to the family, Sphyraenidae showed the lowest moisture content. Highest moisture content was observed in *S. indicus.* The crude protein contents of the fishes ranges from 65.61 to 77.90%. The lowest protein content of 65.61% was recorded for the species, *N. japonicas.* The average crude lipid content of the fishes ranges from 1.31 to 8.68%. The average total ash content of fishes ranges from 14.57 to 25.44% and two species, *N. japonicus* and *E. fuscoguttatus* showed highest values of 22.1 and 25.44%, The carbohydrates contnent of fishes varies from 2.65 to 6.13 %

The mineral composition of fishes caught in Kasimedu landing centre is presented in (Table 5). The average calcium content in the fishes ranges from 171 to 1050 mg%. The phosphorus content of the fishes varies

from 33 to 345 mg/100 g. Similarly iron content of the fishes varies from 0.22 to 16 mg/100 g. Majority of the fishes had the average iron contents < 5 mg%.

The present study was carried out to analyze the proximate and mineral composition of commercially important marine fin fishes landed in (Kasimedu). Morphometric are features important in taxonomic studies and also useful in growth studies (Ali *et al.,* 2017). The wide variations in morphometric parameters exist due to the taxonomical differences in fish species rather than environmental factors (Soundarapandian *et al.,* 2013).

The body indices such as condition factor, HSI, VSI and GSI showed non-significant differences. Condition factor is used to compare the 'condition,' 'fatness' or 'wellbeing' of fish and is based on the hypothesis that heavier fish. Hepatosomatic index is directly related to metabolism because glycogen and lipids can be stored in the liver (Ali *et al.,* 2017). GSI is a useful tool to indicate changes in the reproductive cycle. The relative reproductive condition of the fishes of different sizes is measured by determination of gonad index.

The proximate composition showed significant differences among the fish species. The average moisture content of the fishes ranges from 72.3% to 77.9%. Similar to our results (Kabahenda *et al.,* 2011) reported more or less a similar variation in the moisture contents ranges from 62.4% to 81.1% in various fish species. The percentage of moisture in the fish is a good indicator of the relative energy, protein and fat content (Barua *et al.,* 2012). The proportion of moisture in fish varies widely between 65-90 % although it is normally in the range of 70- 75%. It has been reported that low moisture content is usually associated with the relatively high-fat content and vice-versa (Yanar and Celik 2006). The crude protein contents of the fishes ranges from 65.61 to 77.90%. Similar to our results (Kumar *et al.,* 2014) reported that species, *N. japonicus* alone had slightly lower protein content of 18.24%, wet weight but was similar to that obtained by (Nurnada *et al.,* 2013). Fish is considered as a high-range protein containing nutrient like shrimp. It has been reported that protein content of fish varies depending on fish species 44 to 80% (Sriket *et al.,* 2007). The high protein content in the lowest size groups may be attributed to increased protein synthesis during the active growth phase (Pedrazzoli *et al.,* 1998). Thus, this high protein content may be valuable for food formulation as a protein replacement for other expensive animal protein source in feed production (Ali *et al.,* 2017). The average crude lipid content of the fishes ranges from 1.31 to 8.68%. On the contrary to our results the average fat contents of *Stolephorus* species were between 1.1% and 2.4%, but slightly lower values were recorded by (Gopakumar 1997) for this species. The fish species, *N. japonicus* had 6.63% fat contrary to that obtained by (Gopakumar 1997 and Nurnada *et al.,* 2013). The fish species, *S. flavicauda* contains 8.68 % fat, but (Zamil *et al.,* 1992) reported only 0.98% in *Sphyraena obtusata.* Studies have shown that the fat content is inversely proportional to the moisture content. Variations in age and maturity within the same species may also contribute to the differences in the fat contents. The total ash content of fishes ranges from (14.57 to 25.44) and two species, *N. japonicus* and *E. fuscoguttatus* showed highest values of 22.1 and 25.44%, respectively. Ash is a measure of the mineral content of any food including fish (Kumar *et al.,* 2014). The concentrations of minerals and trace elements that contribute for the total ash contents are known to vary in fish depending their feeding behaviour, environment, ecosystem and migration even within the same area (Kumaran *et al.,* 2012) Fish muscle generally have very low amount of carbohydrates. The average carbohydrate contents in the fishes ranged between 2.65 and 6.13%. The lowest carbohydrate values could be due to the fact that glycogen does not contribute much to the reserves in the fish body tissue (USDA, 2010). The variation in nutrient composition of fishes both from marine environment shows variations due to the seasonal and biological differences species, size, dark/white muscle, age, growth, sex, sexual maturity and spawning, area of catch, processing method, food source and environmental conditions water parameters, salinity and temperature (Turhan *et al.,* 2004).

The analyzed minerals content were significantly different among the species. The fish meat generally contains high calcium content than the animal meat. Majority of the fishes had the average calcium contents between 425 and 1050 mg/100 g. The fishes of families, Clupeidae, Scombridae and Serranidae generally had high calcium values. Similar to our results (Palani kumar *et al.,* 2014) reported the high calcium contents above 1000 mg/ 100 g were *Epinephelus areolatus* and *Rastrelliger kanagurtar*. Iron has several vital functions in the body. It serves as a carrier of oxygen to the tissues from lungs by red blood cell haemoglobin, as a transport medium for electrons, within cells and as an integrated part of important enzyme systems in various tissues. Adequate iron in the diet is very important for decreasing the incidence of Anemia, which is considered a major health problem, especially in young children (Glover and Hogstrand 2002) Minerals are essential nutrients, components of many enzymes and metabolism, and contribute also to the growth of the fish. The human body usually contains small amount of these minerals and the deficiency in these principal nutritional elements induces a lot of malfunctioning; as it reduces productivity and causes diseases (Marichamy *et al.,* 2012).

CONCLUSION

Results from the study revealed that the seven fish species are nutritionally potent with proteins, lipids and minerals can be an efficient diet supplement and it can be encouraged for of human nutrition. However, further studies are required on the fatty acid and amino acid composition of these fishes to provide detailed data on the nutritive values of fishes

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Table 1: Morphmetric parameters of fishes caught in Kasimedu landing centre

S.No	Family	Fish species	Morphometric Parameters					
			Length (cm)	Weight (g)	Std length (cm)	Head length (cm)	Eye diameter (cm)	Body depth (cm)
1.	Clupeidae	*A. sirm*	17.6 ± 0.04	48.20 ± 0.36	14.6±0.03	3.1±0.16	0.9±0.03	3.7±0.46
2.	Engraulidae	*S. indicus*	12.1± 0.06	13.90 ± 0.12	10.2±0.07	2.3±0.14	0.8±0.01	2.8±0.25
3.	Nemipteridae	*N. japonicus*	18.4 ± 0.07	44.27± 0.22	11.6±0.01	2.5±0.13	1.3±0.12	4.5±0.15
4.	Scombridae	*R. brachysoma*	15.9 ± 0.04	73.54± 0.15	14.4±0.03	4.3±0.25	1.2±0.04	4.8±0.01
5.	Serranidae	*E. fuscoguttatus*	23.4 ± 0.01	154.34± 0.08	19.4±0.06	7.5±0.17	1.8±0.02	7.1±0.06
6.	Sphyraenidae	*S. flavicauda*	20.1 ± 0.07	46.97± 0.24	17.0±0.08	5.8±0.16	1.3±0.11	3.4±0.13
7.	Synodontidae	*S. undosquamis*	19.4 ± 0.06	50.54± 0.10	16.5±0.01	3.5±0.07	0.7±0.03	2.8±0.07

Table 2: Food and feeding habits of the fishes

S.No	Family	Fish species	Feeding habit	Type of Feeding
1.	Clupeidae	*A. sirm*	Plankton feeder	Bottom feeder
2.	Leiognathidae	*L. equulus*	Carnivores	Bottom feeder
3.	Nemipteridae	*N. japonicus*	Carnivores	Bottom feeder
4.	Scombridae	*R. brachysoma*	Plankton feeder	Surface feeder
5.	Serranidae	*E. fuscoguttatus*	Carnivores	Bottom feeder
6.	Sphyraenidae	*S. flavicauda*	Carnivores	Surface feeder
7.	Scopelidae	*S. undosquamis*	Carnivores	Bottom feeder

Table 3: Body indices of fishes caught in Kasimedu landing centre

S.No	Fish species	Body indices			
		HSI (%)	VSI (%)	GSI (%)	CF (k)
1.	*A. sirm*	0.24^{a}±0.02	3.36^{d}±0.04	-	0.88^{b}±0.04
2.	*S. indicus*	0.19^{a}±0.01	0.64^{a}±0.04	1.51^{a}±0.04	0.78^{b}±0.01
3.	*N. japonicus*	0.90^{a}±0.04	3.79^{d}±0.02	-	0.71^{b}±0.04
4.	*R. brachysoma*	0.95^{a}±0.02	3.17^{d}±0.03	3.27^{c}±0.04	1.05^{c}±0.02
5.	*E. fuscoguttatus*	0.61^{a}±0.01	1.72^{b}±0.03	2.12^{b}±0.03	1.2^{c}±0.02
6.	*S. flavicauda*	0.10^{a}±0.01	2.26^{c}±0.04	-	0.57^{b}±0.02
7.	*S. undosquamis*	0.10^{a}±0.01	2.26^{c}±0.04	-	0.57^{b}±0.02

Notes: All values are mean ± SE of three observations. Mean bearing different superscript in a row differ significantly ($p < 0.05$).

Table 4: Proximate composition (%) of fishes caught in Kasimedu landing centre

S.No	Fish species	Moisture	Crude protein	Crude lipid	Total ash	Carbohydrates
1.	*A. sirm*	72.41^{c}±0.07	77.36^{d}±0.20	2.52^{a}±0.07	14.57^{a}±0.33	5.45^{e}±0.04
2.	*S. indicus*	77.90^{f}±0.43	76.51^{d}±0.57	4.00^{b}±0.04	16.47^{b}±0.15	2.65^{b}±0.04
3.	*N. japonicus*	75.14^{d}±0.14	65.61^{c}±0.08	6.63^{c}±0.56	22.61^{d}±0.12	5.59^{e}±0.25
4.	*R. brachysoma*	76.41^{e}±0.15	77.90^{d}±0.19	1.31^{a}±0.90	16.19^{b}±0.16	4.56^{c}±0.08
5.	*E. fuscoguttatus*	73.33^{c}±1.05	66.33^{c}±0.28	2.13^{a}±0.06	25.44^{e}±0.49	6.13^{f}±0.07
6.	*S. flavicauda*	72.37^{c}±0.14	69.24^{c}±0.23	8.68^{d}±0.21	17.50^{b}±0.08	4.64^{c}±0.04
7.	*S. undosquamis*	76.50^{e}±0.12	72.85^{d}±0.60	2.46^{a}±0.16	19.63^{c}±0.34	4.94^{c}±0.03

Notes: All values are mean ± SE of three observations. Mean bearing different superscript in a row differ significantly ($p < 0.05$).

Table 5: Mineral composition of fishes caught in Kasimedu landing centre

S.No	Fish species	Mineral contents (mg/100g)		
		Calcium	Phosphorus	Iron
1.	*A. sirm*	916.25^{e} ± 1.10	345.3^{d} ± 2.30	3.91^{b} ± 0.11
2.	*S. indicus*	605.18^{c} ± 2.30	33.02^{a} ± 0.15	2.58^{b} ± 0.10
3.	*N. japonicus*	781.43^{d} ± 1.40	253.12^{c} ± 1.49	0.13^{a} ± 0.02
4.	*R. brachysoma*	1050.39^{g} ± 0.89	85.94^{b} ± 2.24	2.13^{b} ± 0.05
5.	*E. fuscoguttatus*	1220.21^{f} ± 0.21	325.76^{d} ± 1.10	16.46^{c} ± 0.13
6.	*S. flavicauda*	171.18^{a} ± 1.40	324.11^{d} ± 1.13	0.22^{a} ± 0.05
7.	*S. undosquamis*	425.26^{b} ± 1.10	320.48^{d} ± 1.29	0.05^{a} ± 0.01

Notes: All values are mean ± SE of three observations. Mean bearing different superscript in a row differ significantly ($p < 0.05$).

Fig 1. Spotted sardinella (*A. sirm*)

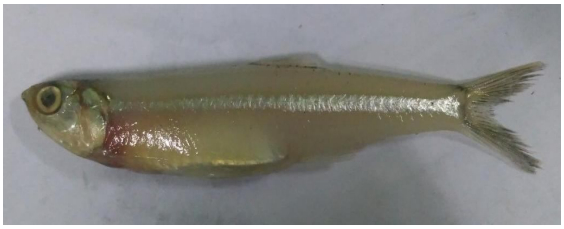

Fig 2. Indian anchovy *(S. indicus)*

Fig 3. Thread fin bream (*N. japonicas)*

Fig 4. Indian mackerel (*R. brachysoma)*

Fig 5.Tiger grouper (*E. fuscoguttatus)*

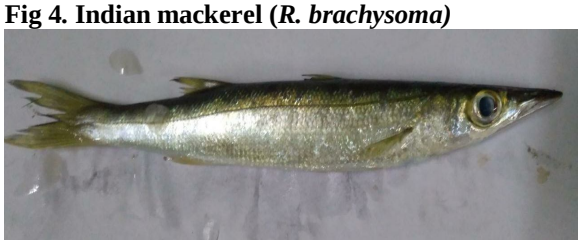

Fig 6. Yellowtail barracuda (*S. flavicauda*)

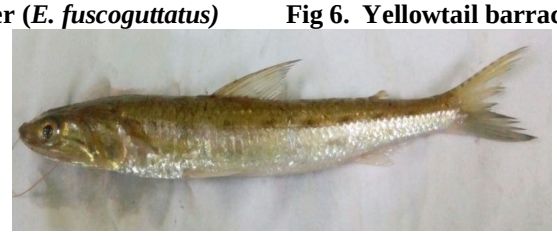

Fig 7. Lizard fish (*S. undosquamis)*

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